TEST Engineering & Management

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

Carbon Credit Market in India: A Missed Opportunity

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Article Info
Volume 83
Page Number: 3097 - 3109
Publication Issue:
March - April 2020

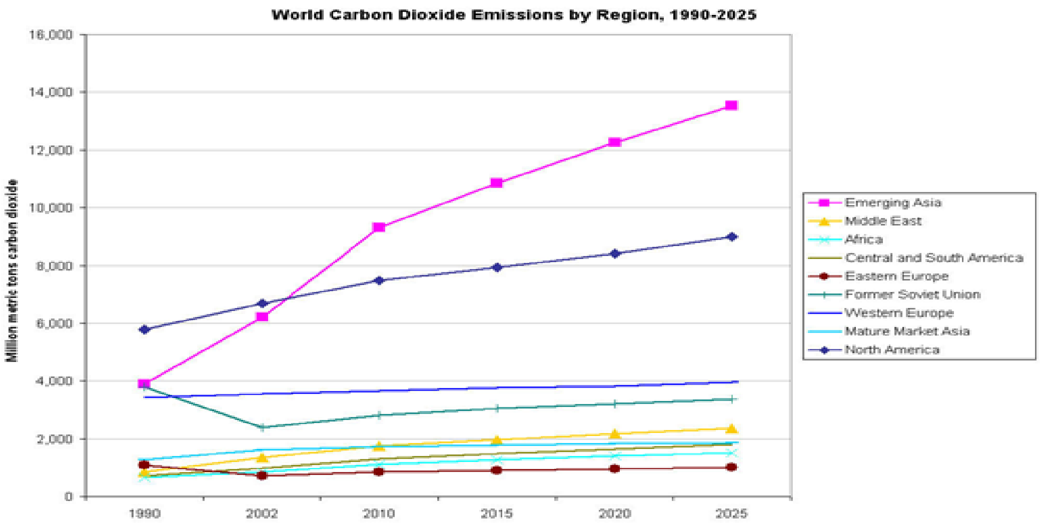
Article History
***Article Received**: 24 July 2019*
***Revised**: 12 September 2019*
***Accepted**: 15 February 2020*
***Publication**: 21 March 2020*

Abstract:
Climate change is a major concern. Global warming is the most systemic and long-run threat to environmental health. Rising levels of development and the race for modernization in all parts of the world has contributed severely to alarming levels of air pollution. This has eventually lead to global warming and climate change. The problems resulting from high levels of air pollution are widely recognized all over the world. Environmentalists and economists are now working towards climate change and global warming with a focus on developing legal tools and regulatory frameworks. This will help move societies toward energy sustainability in order to protect the ecosphere by rising sea levels and varying weather patterns. Carbon dioxide (CO2) is one of the most strong and harmful greenhouse gas produced by ignition of fuels. Its concentration has been rising alarmingly in the atmosphere, and is a big cause of global panic. Under the Kyoto Protocol (1997; 2005), a mechanism of trading carbon was introduced as one of the solutions to the perilous problem of increasing levels of air pollution globally. Carbon Emission Reductions (CERs), then emerged as a commodity in the international derivative trading market. It was a new commodity to be traded in India. The trading of CERs started in the month of April, 2008 on the Multi Commodity Exchange (MCX) in India and ended in November 2011. Present study examines the variables that impacted the price of Indian carbon credits in international market. The study formulates an empirical relationship between the CER spot market and the macroeconomic factors that regulate the spot price of carbon credits viz. crude oil prices, natural gas prices and exchange rate of rupee (₹) against the dollar ($). The results show a significant relationship between CER spot prices and natural gas prices. Whereas, crude oil prices and the exchange rate do not impact CER spot prices significantly. The study also concludes that the collapse of the market was due to the extinct demand of Indian credits in the international market. Largely, it is considered as a missed opportunity for India.
Keywords: *Emission trading, carbon credits, CERs (Certified Emission Reductions) exchange rate, natural gas prices,*

I. INTRODUCTION

Clean air is a foremost fundamental right of all the living beings on earth. Rising levels of development and the race for modernization in all parts of the world has contributed severely to alarming levels of air pollution. Combustion of fossil fuels by human beings is one of the major reasons of emissions of carbon dioxide (CO_2) in the environment. CO_2 is one of the greenhouse gases (GHG) that causes climate forcing/ radiative forcing and adds to global warming. The major GHG emitted by power, cement, steel, textile, and fertilizer industries are carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons (CFCs), hydro fluorocarbons (HFCs). The presence of these gases affects the atmosphere's capability to trap infrared energy and therefore affect the weather and climate in an adverse manner. Many industries release GHG like, methane, nitrous oxide and hydro fluorocarbons as a by-product of their production processes. These gases adversely affect the ozone layer and leads to global warming. Carbon emissions from the production of energy and industrial developments are now intensely rooted in almost all the economies of the world. Figure I demonstrates the actual and projected global CO_2 emissions on a regional basis.

Figure I: World CO_2 Emissions by region



Source: Environmental Impact Assessment report 2005

CER trading is the prime component of emissions trading mechanisms that have been employed universally in order to reduce pollution levels and mitigate global warming. The idea of carbon credits originated when almost all the countries aimed to reduce pollution levels in the atmosphere without disrupting their rate of economic growth. The mechanism for the same was formalized in an international agreement 'Kyoto Protocol' where more than 170 countries agreed to the system through Marrakesh Accords held subsequently. The Kyoto Protocol was an amendment to the United Nations Framework Convention on Climate Change (UNFCCC). The signatories to the protocol committed to reduce their emission of six GHGs including Carbon Dioxide (CO_2), or participate in trading emissions if they need to continue emitting these gases at current levels or increase emissions beyond it. Carbon credits are considered as an integral part of all the international and national emission trading schemes that have been implemented universally in order to reduce the impact of global warming. They provide an incentive to reduce the total effect of GHG emissions industrially by capping gross emissions on an annual basis and determining the monetary value of the shortfall of emissions, if any, through market trading. Carbon credits can be traded internationally or exchanged business wise at the prevailing price in the market. Schemes aimed at reducing carbon emissions can be financed globally through the credits generated. Carbon credits can also be sold to various institutional and non- institutional customers willing to lower their carbon footprints voluntarily. The off-setters of carbon can readily purchase credits from a carbon development company which has accumulated credits from its various projects. The value of the carbon credits is established by the CER authentication procedure and the credibility of the investment or the company that has sponsored the carbon project. The increased value is an indication of augmented participation as well as intense competition signaling a rising demand for these credits globally.

DETERMINANTS OF CO2 AND ITS PRICE- A REVIEW OF LITERATURE

In order to control the upsurge of respiratory diseases and increasing health cost in India, air pollution levels need to be controlled on an urgent

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

basis, *Pahwa and Jain (2015)* recommended in their scholarly work. According to them, "Integrated air quality management (AQM), which is an evaluation and monitoring tool, is a challenge to carry out in most developing countries because of the lack of information on sources of air pollution and insufficient ambient air monitoring data that is available in the public domain".

According to a report "India: State of Environment – 2001" the major sources of air pollution has been attributed to rapid industrialization and urbanization of the Indian economy. The problem has been worsened due to the inadequate power supply in industries and domestication where there is large dependence on diesel based generation units which release a tremendous amount of NO_2 and SO_2.

The '*polluter pays principle'* which lays the foundation for carbon pricing, is discussed by *Bowen, A (2011*). The author has explicitly stated the importance of a uniform carbon price setting across sectors in order to minimize the cost. This would be beneficial as it will reduce the burden imposed on different sectors. According to him, a major challenge to price carbon would be to communicate to the policy makers, businessmen and public the need for a tax on carbon. The proposers of the policy will have to explain as to how the current prices of goods and services do not incorporate the cost of climate change influences that future generations are liable to pay. The importance arises to explain the policy with close reference to *"the polluter pays"* principle; a failure in this case would result in lack of public support. His study states that carbon price imposed should reflect the marginal cost of emitting an extra unit of carbon dioxide. As a result of which the profit maximizing firms will not be willing to produce more than the marginal abatement cost. One of the scientific problems that arise is the basis of differentiating global warming caused by carbon and the global warming caused by precipitation changes, CFC's, sea level rise, etc. There are two main methods of establishing a carbon price which are explained in his research. The first method involves the government levying a tax or duty on carbon. The second method is known as a cap-and-trade method which sets a limit or "cap" on emissions. CER prices are determined to a great extent by market forces of demand and supply of carbon credits and offer great financial benefits through trade, subject to market risks. The impact of carbon credit on the stock market and the impact of indices such as carbonex, greenex, mcsi on the carbon market was studied by *Kumari, Divya, Revanth and Shwetha* (2013). They made use of statistical tools like skewness, kurtosis and correlation and stated that factors like oil and gas price, power and population play an important role in determining carbon prices. Market variables such as exchange rate, GDP of a country and energy prices play a crucial role in determining the price of carbon credits in the market. Studying their movement dynamics and causality with CER prices would provide a useful insight into the carbon trade thereby benefitting the trading parties. Bataller, Maria, Tornero, Ángel, Valor and Enric (2006) examined the influence of various weather and non-weather factors on carbon credit prices by observing daily futures prices of Brent and Natural Gas and electricity futures contracts from January to November, 2005. They used econometric techniques such as Kruskal-Wallis Statistic, Newey-West covariance matrix estimator and least squares estimation techniques and found that the variables like coal (emission intensive energy variables) have a significant impact on the carbon returns. They also found that theimpact of weather variables on carbon prices was lesser significant as compared to non-weather (energy) counterparts. Paolella and Taschini (2008) studied the effects of banking regulations on carbon prices. Weather events and energy prices include the effect of oil, coal and gas prices along with the fuel substituting capacities and preferences of industries. According to them, another significant determinant of the CO_2 price is marginal fuel-switching costs, i.e., the cost of switching from high carbon-intensive sources of energy (for example, coal) to low carbon-intensive sources for power and heat generation (for example, gas). Carraro, C and Favero, A (2009) found that the accessibility and

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

availability of carbon-free technologies in future plays an important role in determining the equilibrium carbon prices. Yu and Mallory (2014) studied the nominal and weekly Spot EU/USD exchange rates, European Emission Allowances (EUAs) carbon credit prices along with the prices of natural gas and coal to find the effect of currency exchange rates on the carbon market. They used Augmented Dickey Fuller unit root, Johansen trace test, Impulse Response Functions and forecast error variance decomposition (FEVD) and found that depreciation (appreciation) of a local currency caused low (high) carbon prices through the energy substitution mechanism. They also found that a depreciation in Euro resulted in a reduction in the price of carbon credits. Julien Chevallier (2013) scrutinized the inter-relationships between the EU 27 industrial production index and the price of CO_2 in a nonlinear structure. He used a threshold VAR model (TVAR) to the carbon-macroeconomic association, and confirmed an existence of a relationship between CO_2 futures prices and macroeconomic activity. According to Sorell and Sijm (2003), policy interaction has been largely neglected in the economics literature. The instruments individually have been widely discussed and adopted, but there has been lesser reliance on the policy mix as a tool for the overall reduction in carbon emissions. The CER generating capacity of many Indian companies was analyzed by *Birla, Singhal, Birla and Gupta (2012)*. They found the market economically beneficial as we could earn great revenue by generating CER's and also be able to reduce emission of GHG in our country. The cases of giant Indian CER generators such as Tata Steel, Gujarat Chemicals etc. were also reviewed by them. They stated that a developing nation like India could earn substantiate monetary benefits through CER's. However, they doubted the role played by carbon market in actual reduction of GHG as pollutants, as through CDM, the non-polluters sell off right to pollute to the largest bidder, which earns them revenue, but nature eventually gets polluted. The paper suggested construction of an effective carbon legislative market which is more liquid and cost effective, and it was believed that with active participation from the developing world, the global carbon market shall become the second largest financial market by 2020. According to a study by Upadhyaya, P (2011), "the Emission Trading Scheme was not found viable for India in immediate future". This was because of the possible challenges that the scheme would face in India: point of regulation, GHG emission sources, and choice of allocation method. There have been very few studies that discussed Carbon Trading and its future in India. Since the effective spot price of a single credit on 10th June 2008 was ₹ 1380. There was a nominal demand for these credits worldwide. But due to multiple reasons, the demand kept falling. By 24th November 2011, the price fell to ₹ 414. And eventually it dropped to *'zero'* because of lack of demand in the world market for Indian credits. This is a matter of grave concern for the country. Lack of authenticity of the credits, absence of a regulatory authority and proper monitoring of reductions in carbon emissions resulted in diminishing demand for these credits universally. Against this background, present study attempts to formulate an empirical relationship between the CER spot market and the macroeconomic factors that regulates the spot price of carbon credits viz. coal/crude oil prices, natural gas prices and exchange rate of rupee (₹) against the dollar ($).

II. DATA AND METHODOLOGY

The data for the study is collected from several secondary sources. The exchange rate between Indian currency and the US dollars is collected from the Reserve bank of India's (RBI) official website. The energy prices and Carbon Emission Reduction (CER) spot prices is collected from Multi Commodity Exchange India's official Statistical database portal. The Multi Commodity Exchange of India Ltd (MCX) is a demutualized exchange with permanent recognition from the government of India. MCX allows for trading in 56 commodities, like, bullion, energy, grains, plastics, metals, oil and oilseeds, fibers, spices, pulses, sugar, plantations and carbon credits. The period of study considered in this study begins from 31st March, 2008 because the trading of carbon started in our country only then. Trading discontinued on 24th November 2011. So the period of study considered here is April 2008 to November 2011. All prices are taken on a daily basis. One limitation of the data is that Brent oil prices are taken in place of coal prices due to non-availability of coal prices on a daily basis. Also, since there is enough literature supporting the view that natural gas emits lesser carbon as compared to either oil or coal, hence we check the correlation of both Natural gas and Brent oil on the CER Spot prices. Hayhoe, Kheshgi, Jain and Wuebbles (2002) also finds that a substitution of natural gas against continue use of coal leads to a reduction in temperatures by decreasing the emissions of CO_2 and black carbon in the atmosphere. Present study uses a simple regression model to estimate the relationship between spot prices of carbon credits and the three macroeconomic variables viz. coal/crude oil, natural gas and exchange rate of rupee (₹) against the dollar ($). Firstly, the correlation between CER Spot Prices and the three macro-economic is checked. Secondly, the time series stationarity of sample series has been tested using Augmented Dickey Fuller (ADF, 1981). The ADF test uses the existence of a unit root as the null hypothesis. To double check the robustness of the results, Phillips and Perron (1988) test of stationarity has also been performed for the series. Thirdly, in order to check for the long term dynamics between the variables, we implement Johansen (1988) cointegration technique. Subsequently, Vector Error Correction Model (VECM) was used to understand the short term dynamics between the variables. Lastly, we performed Granger (1969) causality criteria to recognize the direction and order of short-term and long-term equilibrium relationships.

III. ANALYSIS AND INTERPRETATION

The correlation coefficients between CER spot prices and the three macro-economic variables are shown in Table 1.

Table 1: The correlation coefficients between variables

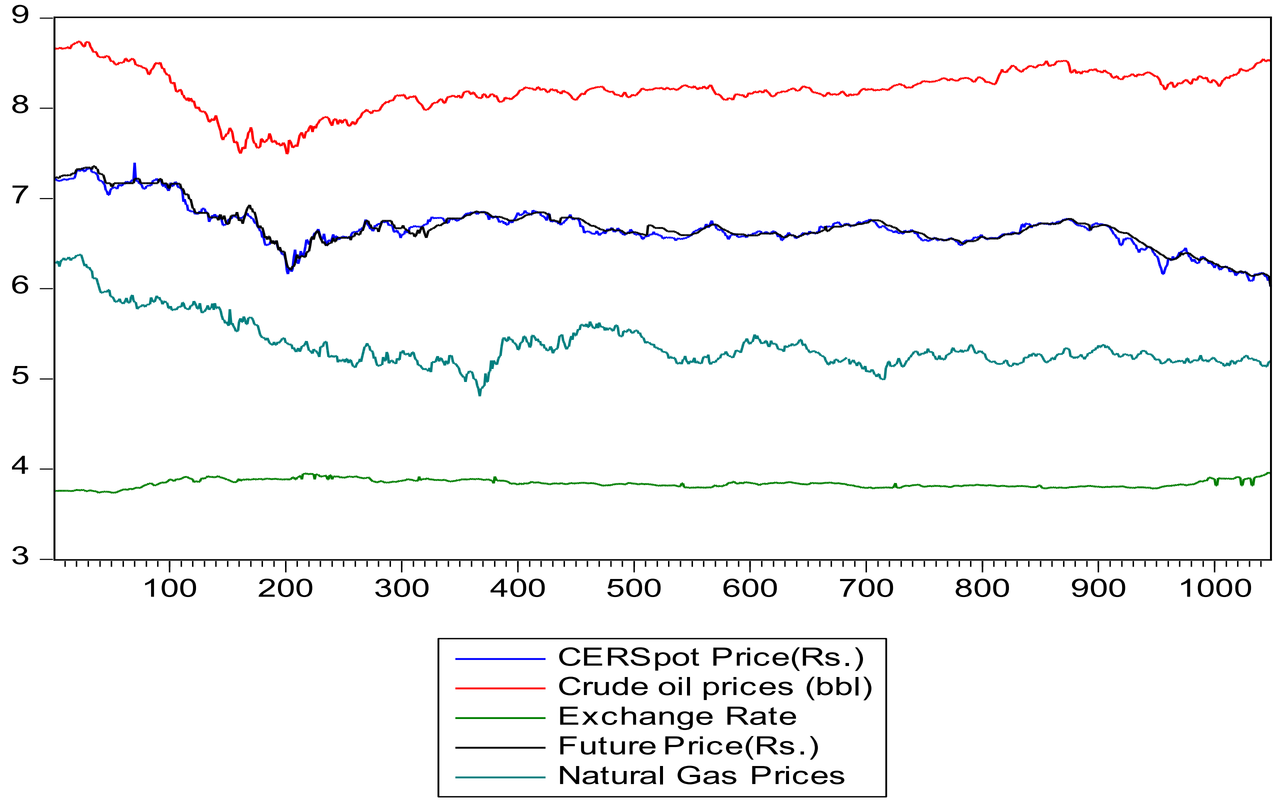
	Exchange rate (₹ per $)	**Crude oil Prices (₹ per bbl)**	**Natural Gas Prices**
CER Spot Prices	-0.357980	0.254087	0.687242

The above table shows the correlation coefficients between CER spot prices and the three key variables under consideration

Results show that there exist a strong correlation between CER Spot and Natural Gas Prices. Whereas, there exist a negative association between CER Spot prices and the Exchange rate. Crude oil prices and CER spot prices are weakly related but they are moving in the same direction. Figure II diagrammatically explains this relationship. The figure also shows the movement of CER future market.

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

Figure II: Graphical representation of the relationships between the variable



In order to establish the nature and extent of an impact of various factors that drive the prices of carbon credits in India, regression has been run by creating the Multivariate Linear Regression equation is as follows:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_i$$

Where,

Y_i = CER prices

X_1= Exchange rate between USD/INR

X_2= Energy Prices (Natural gas)

X_3 = Crude Oil Prices

And, α and β's are the intercept and slope co-efficients respectively, ε_i is the stochastic error term.

Stationarity as a property of a time series data implies the statistical parameters of mean and variance to be constant over a period of time with co-variance between the two-time periods being affected only by the distance between given periods and not the actual time at which computation of co-variance was actually done. Stationarity of data is checked by the existence of a Unit Root, for which the most frequently used Augmented Dickey- Fuller (ADF) test and Philips Perron (PP) have been used. It would seem tempting to use the usual *t- test* to check the stationarity, but unfortunately we cannot do that because the 't' test is valid only if the original time series is stationary. However, we can use a test developed by statisticians Dickey and Fuller, called the *tau* (τ) – *test.*

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

Table 2: Tests of Stationarity at Level

	ORIGINAL SERIES AT LEVEL					
	ADF			PHILIP PERRON		
	(p value)	τ-statistic		*(p value)*	τ-statistic	
		Critical Value	Actual Value		Critical Value	Actual Value
CER Spot Prices	0.5883	-2.8639	-1.3904	0.5796	-2.8639	-1.4080
Natural Gas Prices	0.0173	-2.8640	-3.2540	0.0152	-2.8639	-3.2993
Exchange Rate	0.1881	-2.8639	-2.2521	0.0799	-2.8639	-2.6686
Crude Oil	0.4101	-2.8640	-1.7411	0.3849	-2.8640	-1.7917

Table 2 describes the sample price series that have been tested using Augmented Dickey Fuller (ADF) (1981). The ADF test uses the existence of a unit root as the null hypothesis, that is, a non-stationary series. To double check the robustness of the results, the Phillips and Perron (1988) test of stationarity has also been performed for the series. All tests are performed using 5%level of significance.

As inferred from Table 2, all the logarithmically transformed price series used for the purpose of study, namely, the CER Spot Price series, Exchange Rate and the Crude oil price series are non-stationary at 5% level of significance, at level. However, the logarithmically transformed natural gas price series exhibit absence of a unit root, thereby rejecting the null hypothesis, making the data stationary, as confirmed through the application of both the econometric tests, that is, ADF and PP test at level. Hence, now we take the first difference in order to convert the non- stationary data series into stationary data series. This is shown in the Table 3.

Table 3: Tests of Stationarity at First Difference

	RETURN SERIES (AT FIRST DIFFERENCE)					
	ADF			PHILIP PERRON		
	(p value)	t-statistic		*(p value)*	t-statistic	
		Critical Value	Actual Value		Critical Value	Actual Value
CER Spot Prices	0.0001	-2.8639	-33.9115	0.0002	-2.8639	-33.9045
Natural Gas Prices	0.0012	-2.8640	-35.8164	0.0011	-2.8640	-35.9038
Exchange Rate	0.0011	-2.8639	-21.6925	0.0001	-2.8639	-39.4722
Crude Oil	0.0001	-2.8640	-22.8246	0.0012	-2.8640	-25.4452

Table 3 describes the sample return series that have been tested using Augmented Dickey Fuller (ADF) (1981). The ADF test uses the existence of a unit root as the null hypothesis, that is, a non-stationary series. To double check the robustness of the results, the Phillips and Perron (1988) test of stationarity has also been performed. All tests are performed using 5%level of significance.

After taking the first difference, the return series of all the variables turn out to be stationary as tested by ADF and PP tests demonstrating all the price series to be integrated to order one, i.e., I(1) after having removed the linear trend from unit root test. Presence of I(1) is the pre-requisite for the existence of the long-run equilibrium relationship. Further, for a given price series to be co-integrated they must be

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

stationary at the same order. To study the existence of long term dynamics between the variables, Johansen's Cointegration technique was used with reference to Trace Test and Maximum Eigen Value Test. On studying data variables CER Spot Prices and Price of Natural Gas, it was found that there exist long term dynamics between the two, as similarly comprehended by the Trace test statistic and Eigen Value Statistic. There exist no long run movement of CER Spot Prices with both Brent crude oil prices and Exchange rate. These results are further confirmed by the Trace Test and Maximum Eigen Value Test. (Table 4)

Table 4: Johansen Co-Integration Test

		TRACE TEST			MAXIMUM EIGENVALUE TEST		
		(p value)	Trace-statistic		*(p value)*	Eigenvalue-statistic	
			Critical Value	Actual Value		Critical Value	Actual Value
CER Spot Prices and Natural Gas Prices	3*	0.0323	15.49471	16.71492	0.0320	14.26460	15.48106
CER Spot Prices and Exchange Rate	4*	0.5809	15.49471	6.971897	0.6140	14.26460	5.993731
CER Spot Prices and Crude Oil	2*	0.1502	15.49471	12.14326	0.1155	14.26460	11.87248

This table provides the Johansen's co-integration test, maximal Eigen value and Trace test statistics are used to interpret whether the null hypothesis of r=0 is rejected at 5 % level and not rejected where r=1. Rejection of null hypothesis implies that there exists at least one co-integrating vector which confirms a long run equilibrium relationship between CER Spot Prices vis-à-vis other variables.

Once we know that the time series is co-integrated, one may wish to find out the existence of causality between the two variables. The Granger Causality Test (1969) is an econometric tool to ascertain the existence of causality between two given variables. For example, if one wishes to find causality between Carbon Credit Prices (CP) and Crude Oil Prices, we use the logs of these series, so that their slopes can be interpreted as elasticities. The two equations represent a bivariate VAR, containing lags of both variables, where numbers of lagged values are to be determined by trial and error process (Akaike and Shwarz Information Criteria).

$$LCP_t = \sum_{i=1}^{m} \alpha_i \, LCP_{t-i} + \sum_{j=1}^{m} \beta_j \, LOP_{t-j} + \lambda_1 t + u_{1t}$$

$$LOP_t = \sum_{i=1}^{m} \Upsilon_i \, LOP_{t-i} + \sum_{j=1}^{m} \delta_j \, LCP_{t-j} + \lambda_2 t + u_{2t}$$

Where,'t' is the trend value and 'u' represents the white noise error terms.

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

Granger Causality Test has been applied to determine the existence of a bi- causal relationship of different variables each with respect to the CER spot price. Results are reported in Table 5.

Table 5: Causality between CER Spot Price and the three macro-economic variables

Null Hypothesis	***F-statistic***	***p-value***
CER Spot price does not Granger cause Natural Gas	1.65053*	0.1761
Natural Gas does not Granger cause CER Spot Price	0.94285*	0.4192
CER Spot price does not Granger cause Crude Oil Price	3.43822	0.0325
Crude Oil Price does not Granger cause CER Spot Price	20.4455	0.0002
CER Spot price does not Granger cause Exchange Rate (US $)	1.58125*	0.1770
Exchange Rate (US $) does not Granger cause CER Spot Price	0.30610*	0.8740

Granger Causality as a measure of testing causation between variables in use is performed at 5% level of significance.

**Insignificant*

Results further indicate that there is non- existence of any causal relationship between CER Spot Price and Natural Gas with none of the variables causing any impact on the other. There exists a strong bi-directional relationship between CER Spot Price and Crude Oil Price. This confirms that both CER spot prices and Crude Oil Price exert a great impact on each other. There exist no causal relationship between the CER Spot price and Exchange Rate of Indian rupee against the US dollar ($). That is, there is no significant impact of any of these variables on the other. Vector Error Correction Model (VECM) as an econometric tool used to measure the short term equilibrium adjustments in variables under study to achieve long term equilibrium. The VEC model can be explained mathematically in the form of a general equation given by:

$$\Delta Y_t = B_0 + B_1 \Delta X_t + B_2 (Y_{t-1} - A_1 - A_2 X_{t-1}) + \varepsilon_t$$

Where, Δ represents the first difference operator and ε_t is a random error term. Also, $(Y_{t-1} - A_1 - A_2X_{t-1})$ is the lagged value (one period) emanating from the cointegrating regression $Yt = A_1 + A_2 X_t + \varepsilon_t$.

Table 6 represents the Vector Error Correction Estimates between CER Spot Price and Natural Gas: The coefficient of speed of adjustment of CER Spot Price with respect to Natural Gas Price is (-0.002463). This implies that the correction process in achieving long term equilibrium is negligible. Similarly, the speed of adjustment of the price of Natural Gas with respect to CER Spot Price is extremely low at 1% as depicted by (-0.018213).

Table 6. Vector Error Correction Estimates: CER Spot Price and Natural Gas:

Error Correction	**D(LN_Spot Price)**	**D(LN_Natural Gas)**
Co- integrating Equation	-0.002463	-0.018213
D(LN_Spot Price)_(-1)	-0.01665	-0.096316

D(LN_Spot Price)_(-2)	0.034621	0.028908
D(LN_ Natural Gas)_(-1)	0.000504	0.025524
D(LN_ Natural Gas)_(-2)	-0.025591	-0.026876

Table 7 represents the Vector Error Correction Estimates between CER Spot Price and Exchange Rate. The coefficient of speed of adjustment of CER Spot Price with respect to Exchange Rate is (-0.019856). This indicates that the adjustment process in attaining the long term equilibrium is insignificant. Likewise, the speed of adjustment of the Exchange Rate with respect to CER Spot Price is extremely low at 1% as depicted by (-0.016322).

Table 7. Vector Error Correction Estimates: CER Spot Price and Exchange Rate:

Error Correction	**D(LN_Spot Price)**	**D(LN_Exchange Rate)**
Co- integrating Equation	-0.019856	-0.016322
D(LN_Spot Price)_(-1)	0.069263	-0.138068
D(LN_Spot Price)_(-2)	0.004223	-0.264978
D(LN_Exchange Rate)_(-1)	0.001558	-0.019103
D(LN_Exchange Rate)_(-2)	-0.021279	0.018818

Table 8 represents the Vector Error Correction Estimates between CER Spot Price and Brent oil Prices. The coefficient of speed of adjustment of CER Spot Price with respect to Brent oil prices is (-0.002239). This indicates that the adjustment process in attaining the long term equilibrium is insignificant. Likewise, the speed of adjustment of the Brent oil prices with respect to CER Spot Price is negligible as depicted by (-0.000523).

Table 8. Vector Error Correction Estimates: CER Spot Price and Natural Gas:

Error Correction	**D(LN_Spot Price)**	**D(LN_Crude Oil Price)**
Co- integrating Equation	-0.002239	-0.000523
D(LN_Spot Price)_(-1)	0.011267	-0.008810
D(LN_Spot Price)_(-2)	0.006830	-0.016716
D(LN_Crude Oil Price)_(-1)	0.239403	0.268679
D(LN_Crude Oil Price)_(-2)	-0.108206	-0.098543

March-April 2020
ISSN: 0193-4120 Page No. 3097 - 3109

IV. FUTURE AND SCOPE OF CARBON TRADING IN INDIA

India is emitting about 5% of global pollution. India, being a developing nation, comes under Annexure II of Kyoto Protocol. The primary aim of protocol was to address the problem of climate change and reduce greenhouse gas. According to the convention, countries emitting above the legalized limit of carbon dioxide were required decrease their emissions to approved levels else they should buy carbon credits certificates, that are completely tradable. This is known as Carbon Trading. If any member country is not able to abide by the requirements of the protocol, then they are charged for the same. It was apprehended that developed nations were predominantly responsible for emitting high levels of greenhouse gases; consequently the convention places a considerable burden on developed countries by following the principle of "common but differentiated responsibilities". India emerged as a net seller of the carbon credits to Annexure I countries. In 2012, India generated about 30 million carbon credits and had roughly another 140 million credits to offer. The value of the carbon credits is established by the CER authentication procedure and the credibility of the investment or the company that has sponsored the carbon project. These factors are mirrored in their price; voluntary units typically have less value than the units sold through the rigorously-validated CDMs. The increased value is an indication of augmented participation as well as intense competition signaling a rising demand for these credits globally. Developed countries like Europe and the US are the major buyers of these credits in the world. India being a net seller, started trading these credits on the Multi Commodity Exchange (MCX) in 2008. The effective spot price of a single credit on 10th June 2008 was Rs. 1380. There was a nominal demand for these credits worldwide. But due to multiple reasons, the demand kept falling. By 24th November 2011, the price fell to Rs. 414. And eventually it dropped to 'zero' because of lack of demand in the world market for Indian Credits. This is a matter of grave concern for the country. Lack of authenticity of the credits, absence of a regulatory authority and proper monitoring of reductions in carbon emissions resulted in diminishing demand for these credits universally. Basically, it was a missed opportunity.

According to *Bulkeley, 2006,* "Carbon control is rapidly becoming the 'overriding concern at the heart of sustainable development and it is well on its way to being an overriding apprehension at the heart of public strategy". Carbon control necessitates a significant adaptation of state-society and economy-environment associations as governments seek to deliver on promises to a low carbon future. To accomplish the intended reductions in carbon, governments should find new ways of routing arrays of consumption behavior, through an amalgam of coercion and encouragement. This is mirrored in the present experiment with new forms of socio-spatial parameters, especially Green banking and the obligation to carbon accounting. The fresh supervisory phase of carbon control will be set in motion when national targets are set in post-Kyoto international treaties, and particularly when it becomes clear that much more rigorous measures are required. Nonetheless, there are two ways in which the imperative to realize a low carbon evolution in all countries will bring opportunities as well as challenges.

- Strict and rigorous resolutions about the dissemination of emission quotas between different places, and different interests within those places;
- New necessities for local and regional authorities to manage their territories within their carbon quotas.

At the same time, as the consequences of carbon control are indeterminate, it is assured that rationing carbon will have a substantial impact on the ways in which we think about the sustainable management of the economies. Carbon control will unfold differently in unlike national regulatory frameworks.

V. CONCLUSIONS AND FINDINGS

In this study, we explained the macro-economic determinants of the Carbon Emission Reduction permits in India from March, 2008 to November, 2011. Under the Kyoto Protocol, the member nations had three options to reduce the target carbon emissions:

1. International Emissions Trading
2. Clean Development Mechanism (CDM)
3. Joint implementation (JI)

The adherent nations promised to reduce global temperature by 2% during the First commitment period i.e. 2008-2012. In this study, we primarily looked at the first mechanism to reduce the anthropogenic emissions by member countries. India and China emerged as net sellers of these credits due to their developing status. Till late 2008, there were numerous speculations about the growing economic facet of the carbon market specially in developing nations particularly China and India. In fact, the expected size of the CER market was about 500 million. Multiple factors influence the price of carbon credits in the world market. Carbon trading was welcomed by the global community with open arms. However, India failed to realize the potential of the market. Using the notion of trading carbon, one could have targeted the twin goals of reducing carbon emissions and generating huge revenues for the country. During 2008, we started with a big bang and the spot price was 10th June 2008 was ₹ 1380. There was a nominal demand for these credits. The Clean Development Mechanism (CDM) in India suffered from multiple weaknesses. The delays in project approval and registration, and the existence of operational hiccups had increased the gestation period of projects that served as a source of discouragement to foreign investors who diverted to other global carbon markets. There also exist problems in the policy mix required for the proper functioning of the market. As pointed out by Sorell and Sijm (2003), lesser reliance has been placed on a policy mix required for the appropriate functioning of the Carbon market and only individual instruments have been used and implemented so far. India being a developing nation should learn from the example of EU- ETS (European Union Emissions Trading System) mechanisms in order to take complete advantage of the unexplored potential of the carbon market. Turning to the empirical findings, the results show a significant relationship between CER Spot prices and Natural gas prices. Whereas, crude oil prices and exchange rate does not impact the CER Spot prices significantly. The prices of these credits was also determined significantly by their demand in the international market. The price of Indian credits eventually plunged to *'zero'* to because of lack of demand in the world market for Indian Credits. This is a matter of grave concern for the country. Lack of authenticity of the credits, absence of regulatory authorities and proper monitoring of the reductions in carbon emissions resulted in diminishing demand for these credits universally. Finally, there still exist enormous opportunities for the country by indulging in trading of these credits internationally. The country's higher officials and policy makers should reconsider the problems associated with the Indian Carbon market and come up with a suitable policy mix for the country to initiate the recommencement of the trading of Indian credits in the global carbon market. This would help in the transformation of lost confidence in Indian credits at the global platform. The aforesaid mechanism would lead to the accomplishment of twin goals of revenue generation and carbon emission reduction with the improvement of the overall carbon market scenario of the country. In other words, it would result in killing two birds of with one stone.

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March-April 2020
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